Determinants of Banks' CDS Spreads and Policy Implications

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This paper analyzes the determinants of CDS spreads of major international banks using the data period of 2005~2009, which includes the global financial crisis. Taking into account that CDS spreads of Korean banks, for example, rose sharply although they were financially solid preceding the crisis period, we consider macroeconomic variables that reflect the economic fundamentals and foreign liquidity conditions of the economy, in addition to the financial indicators of banks. Empirical results, based on a panel regression analysis of 40 major international banks, shows that macroeconomic variables such as the fiscal balance, foreign reserves, foreign exposure, and financial indicators such as bank's capital, loan-to-asset ratio, and loan-to-deposit ratio matter significantly in determining banks' CDS spreads. The results also show that certain variables became significant during the crisis period, which implies that it is important to manage and monitor certain variables during such periods.

Keywords: CDS spreads, Panel analysis, Foreign exposure

JEL Classification: G15, G21, G38

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I. Introduction

CDS spreads of Korean banks leveled below 100bps until the collapse of Lehman Brothers and then rose significantly to more than 400bps by the end of 2008. The sharp rise implied increased credit risks at banks, and overall foreign liquidity conditions deteriorated quickly as a result. Although the financial indicators of Korean banks, such as financial soundness, profitability, and capital adequacy, were in good shape relative to major international banks, the increase in CDS spreads of the Korean banks outpaced that of these major international banks. This implies that the determinants of CDS spreads are not limited to micro factors such as the financial conditions of the issuer of the underlying asset, but extend to macro factors such as the degree of systemic risk of the financial system, the government's external liabilities and the soundness of the foreign exchange sector.

This paper attempts to identify exactly what those factors are. Although there have been numerous studies trying to identify the determinants of sovereign credit spreads, it is to our understanding that there has been little exploration into identifying the determinants of banks' CDS spreads. The reasons behind this could be various, but our main speculation is that since CDS trading, which falls in the category of credit derivatives, is a relatively new product compared to other financial derivatives and trades mainly over-the-counter, researchers might have had difficulty in acquiring data for analysis.

This paper analyzes the determinants of banks' CDS spreads and, in particular, tries to find out why Korean banks CDS spreads rose sharply during the global financial crisis, despite their solid financial conditions. This differs from previous studies, especially those on corporate CDS spreads, where market indicators such as stock prices and credit ratings were the main area of focus. Analyzing the effects of macroeconomic variables in addition to the micro financial indicators of banks enables us to study the policy implications of the empirical findings. The inclusion of micro financial indicators such as the loan to asset ratio, the loan to deposit ratio, and Tier 1 capital into the analysis gives us a much richer and broader view of the uniqueness that can be found only within the financial industry. Also, by studying the effects of a crisis event (*i.e.*, the global financial crisis) we can investigate the effects of a possible shift in investors' credit risk appetite due to a crisis.

The paper is organized as follows. First, we briefly review the literature

on CDS spread determinants and distinguish our research from earlier studies. Second, we present the model specification for our empirical analysis. Third, an empirical analysis based on a panel regression is carried out and the results are interpreted. Last, we conclude our paper and derive policy implications.

II. Literature Review

As mentioned above, the literature on studying the determinants of CDS spreads is limited by the relatively short history of CDS trading. We split the literature on determinants of CDS spreads into studies on sovereign CDS spreads and studies on corporate CDS spreads.

A. Literature on Sovereign CDS Spreads

There is little research directly dealing with the determinants of sovereign CDS, instead focusing on the determinants of credit spreads of sovereign bonds. Park and Seo (2006) analyze the determinants of credit spreads of 16 emerging market countries using panel data. They found that variables such as gross debt, external debt repayment, and real GDP exhibit high significance whereas the CPI and US Treasury rates were less significant. Eichengreen and Mody (1998) used a data set consisting of 1,033 launch spreads from 1991 to 1996 and found that launch spreads are more sensitive to market sentiment than economic fundamentals. Grandes (2002) analyzed the sovereign credit spreads of Argentina, Chile, and Mexico between 1994~2000 and concluded that credit spreads were more sensitive to permanent effects rather than transitory effects. Kamin and von Kleist (1999) focused on the regional differences in emerging market credit spreads. Using the data period of 1991 to 1997, they found that investors put a premium on sovereign credit spreads from South American and Eastern European countries over Asian or middle eastern countries. They argue that even after taking into account the relevant country's alleviated risk factor, improved credit ratings and changes in the maturity structure, credit spreads cannot be fully explained without the regional factor. Aizenman and Pasricha (2009) showed, using a data set of 19 countries, that the credit spreads of countries which entered into swap agreements with the Federal Reserve were lower than those of countries that didn't; they also argued that a higher foreign reserves to GDP ratio translates into lower CDS spreads.

B. Literature on Corporate CDS Spreads

The CDS is typically used to hedge the credit risk of corporations so research on corporate CDS spreads is relatively abundant. Academic research on CDS spreads was pioneered by Duffie (1999). Duffie (1999) argued that due to arbitrage, CDS spreads and corporate credit spreads should be identical. That is, if a bond investor enters into a CDS contract for the same underlying asset, then the corporate yield subtracted by the CDS spread should equal the risk-free interest rate since the credit risk has been perfectly hedged by the CDS contract. This implies that CDS spreads should be identical to corporate credit spreads, which came to be known as 'Duffie's parity.' Subsequent literature on CDS spreads therefore focused on empirically verifying 'Duffie's parity,' but studies found that there exists a significant discrepancy between CDS spreads and corporate credit spreads. For example, Houweling and Vorst (2005) reported that there is a statistically significant and persistent discrepancy between CDS spreads and corporate credit spreads and that CDS spreads should be estimated utilizing individual firms' hazard rates and recovery rates rather than corporate credit spreads. Blanco, Brennan, and Marsh (2005), on the other hand, stretched the data sample period, and found that 'Duffie's parity' held in the long run. Furthermore, they discovered that corporate credit spreads were sensitive to economy-wide variables such as interest rates and stock indices, whereas CDS spreads were more prone to movements in individual firms' stock prices.

The literature on the determinants of CDS spreads began with Zhang, Zhou, and Zhu (2005). Noting that 'Duffie's parity' should hold, they based their analysis on Merton's (1974) model of corporate yield determination. Alexander and Kaeck (2008) pointed out that, since the outstanding amount of individual firms' CDS contracts is relatively low, there is a liquidity premium reflected in the CDS spreads. Based on iTraxx, Europe's CDS index, they found that the CDS index is positively correlated with stock market volatility when the stock market is unstable, and is affected negatively by the stock market and interest rate changes when the stock market is stable.

C. Comparison with Previous Research

Most previous studies of CDS spreads have concentrated on the individual characteristics of the firm, while this paper takes into consideration the macroeconomic variables. Analyzing the determinants of CDS spreads

is mostly based on Merton's (1974) model of corporate yield determination and therefore the focus has been concentrated mainly on variables related to the credit risk of the firm. This paper, on the other hand, includes variables such as per capita GDP, GDP growth, foreign reserves, and the fiscal balance, which are also relevant to the CDS spread since macro conditions also affect the individual firm's probability of default. This is particularly important for firms in emerging markets since sovereign risk plays a bigger role.

Also, this paper focuses on banks' CDS spreads. It is our understanding that there is no previous research that deals with the determinants of banks. The banking industry is particularly fertile for research because variables that cannot be found in other industries, such as Tier 1 capital, the loan to asset ratio, and the loan to deposit ratio, can be included in the analysis. Their inclusion enables us to study the managerial implications of CDS spreads movements, since CDS spreads tend to exhibit large swings in turbulent periods.

Also, including macroeconomic variables allows this paper to offer policy implications for stabilizing CDS spreads. This aspect has been neglected in previous work, which has mostly focused on the pricing aspect of CDS spreads.

Lastly, this paper considers the possibility that a regime shift might have occurred during the global financial crisis. Due to an extreme liquidity shortage and default possibilities, counterparty risk became a major concern in CDS trading, and trading dropped to half of usual volume. Therefore, it is highly possible that the more conservative risk appetite of CDS traders might have translated into a regime shift in CDS trading.

III. Model Specification

A. Methodology

We formulate a panel regression model, with a sample size of 680, for a comprehensive study on the determinants of CDS spreads of 40 banks in 16 countries from the first quarter of 2005 to that of 2009. We examine the macroeconomic indicators of each bank's home country as well as the financial conditions of each bank as independent variables. In addition, a paradigm shift is considered to account for the sudden increase in CDS spreads after the bankruptcy filing of Lehman Brothers. We incorporate this by using dummy variables representing the financial

crisis and formulate an interaction term of the dummy variable and relevant independent variables. The estimated model is set up as follows.

$$y_{it}=\beta_0+X'_{it}\,\beta_1+Z'_{ct}\,\beta_2+D_t\cdot X'_{it}\,\beta_3+D_t\cdot Z_{ct}\,\beta_4+\alpha_i+\varepsilon_{it} \tag{1}$$

In Equation (1), the dependent variable y_{it} represents the CDS spread for bank i in period t, and X_{it} consists of financial variables of bank i in period t. Z_{ct} is an independent variable vector that considers the macroeconomic conditions of home country c in period t. D_t has a value of 1 if t falls between the third quarter of 2008 and the first quarter of 2009, otherwise 0. α_i represents the unobservable characteristics of a bank such as organizational culture and brand value. $D_t\cdot X_{it}$ is the interaction term between the financial crisis dummy variable and an independent variable of bank i, while $D_t\cdot Z_{ct}$ is the interaction term between financial crisis dummy variable and an independent variable of home country c. Therefore, β_1 and β_2 demonstrate the change in the CDS spread in response to a change in X_{it} and Z_{ct}, respectively, before the global financial crisis ($D_t=0$). In contrast, $\beta_1+\beta_3$ and $\beta_2+\beta_4$ represent the impacts of X_{it} and Z_{ct} on CDS spreads after the fall of Lehman Brothers ($D_t=1$), as shown in the following equation.

$$\begin{aligned} y_{it}&=\beta_0+X'_{it}\,\beta_1+Z'_{ct}\,\beta_2+\alpha_i+\varepsilon_{it}\ (\text{if } D_t=0)\\ &=\beta_0+X'_{it}\,(\beta_1+\beta_3)+Z'_{ct}\,(\beta_2+\beta_4)+\alpha_i+\varepsilon_{it}\ (\text{if } D_t=1)\end{aligned} \tag{2}$$

For a panel estimation of Equation (2), a random effects or fixed effects model can be utilized to account for α_i. A random effects model assumes that α_i and X_{it} are independent ($E(\alpha_i|X)=0$) and performs an OLS estimation using the variance of the error term. In the case of a fixed effects model, OLS is applied to Equation (3) after subtracting the mean without any assumption regarding the relationship between the unobserved variable α_i and the observed variables.

$$y_{it}-\bar{y}_i=(X_{it}-\bar{X}_i)\beta+(u_{it}-\bar{u}_i) \tag{3}$$

Where $\bar{X}_i$ represents the time average of X_{it}.

The Wu-Hausman Test examines the null hypothesis that α_i and X_{it} are independent to help decide which model should be used for estimation. If the null hypothesis is rejected, the random effects estimation would be biased. If not, one should check which of the two estimations is more efficient. In our study, the Wu-Hausman test results rejected

the null hypothesis and thus we only provide the results of the fixed effects panel estimation.

IV. Empirical Results

A. Main Results

This paper analyzes the impact of macroeconomic variables and bank-specific variables on banks' CDS spreads. Empirical results show that macroeconomic variables have more explanatory power on banks' CDS spreads. Table 1 shows the regression results of the single-paradigm (paradigm shift after the collapse of Lehman Brothers not considered) fixed effects model estimation. The estimation with only macroeconomic variables (model 1) shows greater explanatory power (R^2=0.7194) than the analysis (model 2) using bank-specific variables alone (R^2=0.5404). When both macroeconomic and bank-specific variables were taken into account, as in model 3, the number of statistically significant macroeconomic variables (5) is larger than that of bank-specific variables (2).

The results in Table 1 show that variables such as GDP per capita, GDP growth rate, FX reserves, foreign exposure, FX volatility, asset growth, and the Lehman collapse dummy are statistically significant. Since developed countries tend to have better credit ratings, we expect the coefficient of GDP per capita to be negative. But the results show that there is a positive relationship between GDP per capita and CDS spreads. Most countries in the sample are developed countries, so this might have resulted in the poor negative link between the two variables. The positive relationship may stem from the fact that most of the banks in our sample are from developed countries where CDS trading was prevalent, and therefore that the heightened credit risk resulted in the surge in CDS spreads.

We expected the coefficient of asset growth to be positive from enhanced competition, though M&A and aggressive marketing can raise concerns related to credit risk problems. However, asset growth and CDS spreads were found to have a negative correlation. This may stem from the fact that CDS spreads affect asset growth as well. For example, banks suffering from high CDS spreads will have trouble expanding in size due to funding costs.

Coefficients of other variables have the expected signs. High GDP growth implies the economy is in a boom phase, so banks from such countries tend to have less probability of default. Central banks with

TABLE 1
RESULTS OF SINGLE-PARADIGM FIXED EFFECTS ESTIMATION

Variables	Expected Sign	Model 1		Model 2		Model 3	
		Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
GDP/capita	(-)	81.7***	4.05			87.2***	3.75
GDP growth	(?)	-11.9***	-6.86			-11.9***	-6.74
FX reserves	(-)	-1.0***	-12.87			-1.1***	-12.13
Foreign exposure	(+)	0.1*	1.90			0.1**	2.06
Fiscal balance	(-)	-2.5*	-1.77	N/A		-2.2	-1.54
Current balance	(-)	1.2	1.36			1.2	1.39
FX volatility	(+)	0.5***	5.87			0.5***	5.71
Interest rate	(?)	-1.2	-0.19			-2.3	-0.36
Term spread	(-)	8.13	1.24			8.5	1.28
Log (Tier 1)	(-)			20.8***	3.44	-2.5	-0.44
Asset growth	(+)			-0.5**	-2.21	-0.4**	-2.23
ROA	(-)	N/A		-10.3	-1.10	1.6	0.21
Loan/asset	(-)			-1.1	-1.45	0.1	0.23
Loan/deposit	(+)			0.7***	3.09	-0.2	-0.8
Lehman collapse	(+)	33.6***	3.88	140.1***	20.85	34.7***	3.91
Sample Size		680		680		680	
R^2		0.7194		0.5404		0.7221	

Note: * denotes that the coefficient is significant at the 10% significance level, ** at the 5% level, and *** at the 1% level.

larger FX reserves have more room to bail out banks in trouble, and hence show lower CDS spreads. Countries with larger foreign exposure have a higher tendency to suffer from shortages in foreign liquidity, as Korea experienced during the global financial crisis, so foreign exposure and CDS spreads have a positive correlation. High FX volatility usually implies greater risk of a shortage of foreign liquidity, and therefore countries with high FX volatility should have higher CDS spreads. The CDS spreads of banks soared dramatically after the collapse of Lehman Brothers, so the coefficient of the dummy variable should have a positive sign.

In fact, the magnitude and statistical significance of the Lehman collapse dummy variable has led us to consider the possibility that the Lehman Brothers bankruptcy may have caused a paradigm shift in pricing banks' CDS spreads. Specifically, CDS investors may have changed their views on the risk profile of banks such that banks' CDS spreads are determined by a different mechanism than before. Therefore we have included interaction terms between the Lehman collapse dummy and all other independent variables. Overall, when micro financial indicators and macroeconomic variables are both incorporated (Model 3) not all of the variables are significant. This may be because certain variables capture the relevant information of others. Given that the overall R-squared of the regression is high enough to suggest that the model is well specified, rather than a model misspecification, we think a richer specification can provide more interesting policy implications.

The results in Table 2 show that the effect of most variables changes after the global financial crisis. Most coefficients simply changed in magnitude and statistical significance, but some even changed signs. Note that the correlation coefficient is β_1 or β_2 before the Lehman Brothers collapse and then changes to $\beta_1+\beta_3$ or $\beta_2+\beta_4$ after the event. It is also the case that each coefficient is treated as zero when it is statistically insignificant. The last column in Table 2 shows the correlation after the crisis.[1]

The coefficient of GDP per capita is positive before the crisis, but it changes sign afterwards. This signals that CDS investors perceived following the crisis that banks in more developed countries are less likely to go bankrupt. This is partly from the fact that the 'flight to quality' during the global financial crisis made it harder for banks from less developed countries to roll over their debentures. It may also reflect the fact that the governments of more developed countries, such as the US, bailed out most of their large banks. Note that small and medium sized banks are not included in our sample, as we focused our attention on the 100 largest banks globally.

The coefficients for GDP growth, FX reserves, foreign exposure, and interest rate remain qualitatively similar to the single-paradigm estimation results. And coefficients for the term spread and ROA are statistically

[1] Coefficients shown in the last column reflect the significance of the interaction term. That is, when the interaction term is insignificant, the coefficient of the independent variable for the post-crisis effect is identical to the coefficient of the independent variable for the pre-crisis effect.

TABLE 2
RESULT OF MULTI-PARADIGM FIXED EFFECTS ESTIMATION

Variables	Expected Sign	Pre-Crisis Effect		Interaction Term		Post-Crisis Effect
		Coeff.	t-value	Coeff.	t-value	
GDP/capita	(-)	121.8***	5.60	-224.1***	-7.12	-102.3
GDP growth	(?)	-10.7***	-4.83	3.2	1.03	-10.7
FX reserves	(-)	-0.5***	-6.25	-0.9***	-3.97	-1.4
Foreign exposure	(+)	0.3***	5.67	-0.1***	-3.08	0.2
Fiscal balance	(-)	-4.7***	-3.30	10.3***	4.98	5.6
Current balance	(-)	0.1	0.12	5.9***	4.60	5.9
FX volatility	(+)	1.1***	6.36	-1.2***	-6.74	-0.1
Interest rate	(?)	-16.8***	-2.73	-26.2***	-4.03	-43.0
Term spread	(-)	11.2	1.63	-7.3	-0.83	0.0
Log (Tier 1)	(-)	2.3	0.50	-26.3***	-4.37	-26.3
Asset growth	(+)	-0.2	-1.11	-0.2	-0.82	0.0
ROA	(-)	-7.5	-0.70	0.2	0.02	0.0
Loan/asset	(-)	0.6	1.08	-0.7*	-1.98	-0.7
Loan/deposit	(+)	-0.3*	-1.94	0.3**	2.26	0.0
Lehman collapse	(+)	2937.8***	8.22	N/A	N/A	2937.8
Sample Size				680		
R^2				0.8308		

Note: * denotes that the coefficient is significant at the 10% significance level, ** at the 5% level, and *** at the 1% level.

insignificant, as in the single-paradigm analysis.

The coefficient of fiscal balance became significant in the multi-paradigm analysis, and changes sign after the crisis. Before the crisis, sound fiscal balances were correlated with lower CDS spreads because fiscally stronger governments have more resources to support their banks in times of trouble. However, shakier fiscal balances are correlated with lower CDS spreads after the crisis. This may be due to the fact that the flight to quality made banks from highly developed countries have relatively lower CDS spreads, even though those countries, such as the US and Japan, had the worst fiscal budget conditions (positive correlation between current account balance and CDS spreads after the crisis may be explained in a similar fashion, except that Japan is not an appropriate example). It may also be the case that banks from countries with bad fiscal balances received more funding from the government such that a worsening in the fiscal balance actually lowered CDS spreads.

FX volatility negatively affects CDS spreads before the crisis, but it suddenly changes direction after the crisis. We still believe that the vol-

atility of currency has a negative impact on banks' viability, but the coefficient may show unexpected signs due to collinearity with GDP per capita. The correlation between FX volatility and GDP per capita is -50.98 with statistical significance.

Long-term interest rates show a negative correlation with CDS spreads. Higher interest rate may increase the default likelihood of banks due to an increase in the interest burden of their debtors. However, low interest rates may increase systemic risk due to asset bubbles. The negative correlation can be interpreted as evidence that the world economy suffered more from low interest rates than high interest rates during the sample period. The asset size of banks had nothing to do with CDS spreads before the crisis, but suddenly showed a strong negative correlation afterwards. This may imply that bailing out the largest banks in each country led investors to believe in too-big-to-fail after the crisis.

Bank's debt-to-assets ratio had no effect on CDS spreads before the crisis, but had a negative correlation after the crisis. This implies that CDS investors realized that banks with a stronger retail base are safer than banks focusing on investment banking. The loan to deposit ratio used to have a negative correlation with CDS spreads, but the effect wears out after the crisis. Since banks with more loan opportunities tended to have a higher loan to deposit ratio, the loan to deposit ratio was negatively correlated with CDS spreads. But CDS investors learned the importance of retail funding from the Northern Rock experience, so the negative correlation disappears afterwards.

B. Robustness of Results

This study finds that banks' CDS spreads depend more on macroeconomic variables than the business performance of banks. However, it is not clear if this is because of the fact that banks' default risk is related to their home countries' default risk or that banks' default risk itself depends on macroeconomic factors. Therefore, further analysis is performed to see if banks' CDS spreads is affected by macroeconomic variables after we separate default risk of banks from that of their home countries.

To separate country CDS spreads from banks' CDS spreads, we first estimate the Equation (4):

$$CDS_{it} = \beta_0 + \beta_1 NCDS_{it} + \alpha_i + \varepsilon_{it} \tag{4}$$

where $NCDS_{it}$ represents the CDS spread of the home country.

TABLE 3
RESULT OF MULTI-PARADIGM FIXED EFFECTS ESTIMATION ON THE ERROR TERM

Variables	Expected Sign	Pre-Crisis Effect		Interaction Term		Post-Crisis Effect
		Coeff.[1)]	t-value	Coeff.[1)]	t-value	
GDP/capita	(-)	78.6***	2.82	-99.3**	-2.17	-20.7
GDP growth	(?)	-5.5**	-2.30	0.8	0.24	-5.5
FX reserves	(-)	-0.2***	-2.60	0.6	1.20	-0.2
Foreign exposure	(+)	0.3***	3.07	0.3***	3.43	0.0
Fiscal balance	(-)	-0.5	-0.31	2.9	1.10	0.0
Current balance	(-)	0.5	0.44	6.1***	3.67	6.1
FX volatility	(+)	0.3	1.45	0.1	0.42	0.0
Interest rate	(?)	25.0***	3.42	-10.8	-1.39	25.0
Term spread	(-)	33.8***	4.52	-49.8***	-4.43	-16.0
Log (Tier 1)	(-)	4.9	0.96	-36.2***	-5.38	-36.2
Asset growth	(+)	-0.0007	-0.00	-0.3	-0.90	0.0
ROA	(-)	2.0	0.18	12.1	0.80	0.0
Loan/asset	(-)	-0.7	-1.18	-0.9**	-2.09	-0.9
Loan/deposit	(+)	-0.4**	-1.99	0.1	0.35	-0.4
Lehman collapse	(+)	1466.5***	2.84	N/A	N/A	1466.5
sample size				527		
R^2				0.7125		

Note: * denotes that the coefficient is significant at the 10% significance level, ** at the 5% level, and *** at the 1% level.

Then we calculate the estimated value of $\widehat{CDS}_{it}$ using $\hat{\beta}_0$, $\hat{\beta}_1$, and $\hat{\alpha}_i$ as in Equation (5) below.

$$\widehat{CDS}_{it} = \hat{\beta}_0 + \hat{\beta}_1 NCDS_{it} + \hat{\alpha}_i \tag{5}$$

Since $\widehat{CDS}_{it}$ represents the value of bank i's CDS spreads in period t explained by the CDS spreads of its home country, the difference between $\widehat{CDS}_{it}$ and CDS_{it} denotes the portion of banks' CDS spreads that cannot be explained by their home countries' default risk. Therefore, we define e_{it} as banks' default risk premium unrelated to home countries' default risk as in Equation (6):

$$e_{it} = CDS_{it} - \widehat{CDS}_{it} \tag{6}$$

Afterwards, we run a multi-paradigm fixed effects panel regression on

TABLE 4

RESULTS OF MULTI-PARADIGM SINGLE-FACET FIXED EFFECTS ESTIMATION

Variables	Macro only		Micro only	
	Pre-Crisis	Interaction	Pre-Crisis	Interaction
GDP/capita	121.8***	-262.3***		
GDP growth	-10.7***	3.4		
FX reserves	-0.5***	-1.1***		
Foreign exposure	0.3***	-0.1***		
Fiscal balance	-6.6***	12.9***		
Current balance	-0.2	5.4***		
FX volatility	1.0***	-0.9***		
Interest rate	-12.5**	-25.7***		
Term spread	12.6*	-8.1		
Log (Tier 1)			22.5***	-37.0***
Asset growth			-0.2	-0.4
ROA			-58.1***	60.0***
Loan/asset			-1.0	-0.1
Loan/deposit			0.6**	0.3*
Lehman collapse	3069.8***		467.6***	
sample size	680			
R^2	0.8203		0.6002	

Note: * denotes that the coefficient is significant at the 10% significance level, ** at the 5% level, and *** at the 1% level.

e_{it}, as in Equation (7). Note that it was not possible to retrieve CDS spreads data for India (ICICI Bank), Holland (ING Bank), Swiss (Credit Suisse, UBS) or the UK (RBS, Barclays, HBOS, Lloyds TSB, Standard Chartered), so the sample size was reduced to 527.

$$e_{it} = \beta_0 + X'_{it}\,\beta_1 + Z'_{ct}\,\beta_2 + D_t \cdot X'_{it}\,\beta_3 + D_t \cdot Z_{ct}\,\beta_4 + \alpha_t + \varepsilon_{it} \tag{7}$$

The results in Table 3 suggest that macroeconomic variables remain more important than bank-specific variables, even after we separate home country risk from bank risk. This implies that banks' default risk itself depends more on home countries' macroeconomic factors.

Our analysis also shows that macroeconomic variables such as GDP and GDP growth are relatively more important in understanding CDS movements than financial indicators from individual banks. Also, it is ascertained that the effects of these variables change significantly during the global financial crisis. Thus, it would be necessary to check if the relative importance between macroeconomic and microeconomic variables

continues to hold in the multi-paradigm model.

Results in Table 4 show that macroeconomic variables have still more explanatory power in the multi-paradigm setting. The R^2 of estimation using macroeconomic variables is 0.8203, and that of bank financial indicators is only 0.6002. Moreover, 8 out of 9 macroeconomic variables have a statistically significant coefficient, whereas this is true for only 3 out of 5 of the microeconomic variables.

Multicollinearity problems may arise when independent variables show high correlation with statistical significance. There is no defined standard in determining multicollinearity, but an absolute value exceeding 0.8 may cause trouble. GDP per capita and foreign exchange reserves exhibit the highest correlation, at -0.8423. However, the two variables cannot be replaced by other measures.

Lastly, country dummies were also constructed to check if there are more country specific factors that need to be controlled for in the regression. However, none of the country dummies were statistically significant.

V. Conclusion and Policy Implications

This paper analyzed the determinants of CDS spreads of major international banks. The empirical findings show that macroeconomic variables and external variables, rather than banks' financial indicators, such as GDP, GDP growth, the fiscal balance, the current account, foreign reserves, and foreign exposure are major determinants of banks' CDS spreads. It is worthwhile to note the significance of the fiscal balance to the GDP ratio variable, since it implies that the recent increase in Korea's public debt should be managed prudently in order to avoid any instability in CDS spreads. Recent concerns by foreign investors on Korea's rise in public debt can be perceived along this line. Also, higher foreign reserves to short term debt and less foreign exposure measured by outstanding foreign currency denominated bond issuance both contribute to CDS spread stabilization, implying that foreign reserves accumulation and limits on foreign exposure is important. Since foreign exposure is linked with overall foreign debt exposure, this underlines the importance of external debt management by the government.

Among market indicators, exchange rate volatility mattered in the pre-crisis period but was less significant during the crisis period. This may be due to the fact that other variables are incorporating shifts in exchange rate volatility during the crisis period. Long term interest rates

TABLE 5

CORRELATION ANALYSIS OF INDEPENDENT VARIABLES

	GDP/ capita	GDP growth	FX reserves	Foreign exposure	Fiscal balance	Current balance	FX volatility	Interest rate	Term spread	Log (Tier1)	Asset growth	ROA	Loan/ asset
GDP growth	-0.4209 (0.0001)												
FX reserves	-0.8423 (0.0001)	0.4446 (0.0001)											
Foreign exposure	0.4084 (0.0001)	-0.2733 (0.0001)	-0.4086 (0.0001)										
Fiscal balance	0.0457 (0.2345)	0.5249 (0.0001)	-0.0003 (0.9946)	-0.1669 (0.0001)									
Current balance	0.0871 (0.0232)	0.0013 (0.9728)	0.0687 (0.0734)	-0.0138 (0.7194)	0.1047 (0.0063)								
FX volatility	0.0525 (0.1716)	-0.5098 (0.0001)	-0.1104 (0.0040)	0.1708 (0.0001)	-0.1068 (0.0053)	0.0489 (0.2026)							
Interest rate	-0.4644 (0.0001)	0.4065 (0.0001)	0.3966 (0.0001)	-0.1771 (0.0001)	0.2660 (0.0001)	-0.3861 (0.0001)	-0.0332 (0.3869)						
Term spread	-0.0694 (0.0703)	-0.5458 (0.0001)	0.0400 (0.2974)	0.0558 (0.1462)	-0.4974 (0.0001)	0.1561 (0.0001)	0.3446 (0.0001)	-0.5020 (0.0001)					
Log (Tier 1)	0.4057 (0.0001)	-0.2438 (0.0001)	-0.2865 (0.0001)	0.1758 (0.0001)	-0.3160 (0.0001)	0.1698 (0.0001)	-0.1163 (0.0024)	-0.3193 (0.0001)	0.0554 (0.1491)				
Asset growth	-0.0511 (0.1830)	0.0140 (0.7161)	0.0485 (0.2066)	-0.0125 (0.7444)	-0.0483 (0.2087)	-0.0129 (0.7375)	-0.0220 (0.5663)	0.0411 (0.2845)	0.0193 (0.6156)	0.0151 (0.6943)			
ROA	-0.2989 (0.0001)	0.3600 (0.0001)	0.2294 (0.0001)	-0.2196 (0.0001)	0.1290 (0.0007)	-0.2415 (0.0001)	-0.2200 (0.0001)	0.3600 (0.0001)	-0.3170 (0.0001)	-0.3720 (0.0001)	0.0946 (0.0136)		
Loan/ asset	-0.2380 (0.0001)	0.1237 (0.0012)	0.1186 (0.0019)	-0.2499 (0.0001)	0.2497 (0.0001)	-0.4657 (0.0001)	0.1073 (0.0051)	0.4334 (0.0001)	-0.1489 (0.0001)	-0.5615 (0.0001)	0.0084 (0.8270)	0.3074 (0.0001)	
Loan/ deposit	-0.1426 (0.0002)	0.1119 (0.0035)	0.0352 (0.3597)	-0.1492 (0.0001)	0.2807 (0.0001)	-0.4786 (0.0001)	0.1245 (0.0011)	0.3910 (0.0001)	-0.1906 (0.0001)	-0.4140 (0.0001)	-0.0044 (0.9092)	0.2324 (0.0001)	0.7416 (0.0001)

Note: Shaded area represents that the correlation is statistically significant at the 5% level.

showed a negative relationship with CDS spreads implying lower interest rates may be acknowledged as a signal of increased credit risk. Among banks' financial indicators, the loan to asset ratio, loan to deposit ratio, and Tier 1 capital affected CDS spreads, underlining the importance of managing these variables to stabilize CDS spreads.

Overall, this paper stresses the fact that the credit risk of major international banks, measured by their CDS spreads, is more dependent on macroeconomic variables than individual financial indicators. This implies that maintaining a sound macroeconomic environment is crucial for the stabilization of banks' CDS spreads. Also the change of signs of

certain variables during the crisis period indicates that movements of certain variables should be well monitored. A change in the significance of specific variables (*i.e.*, insignificant during normal times, but significant during crisis) also underlines the importance of managing specific variables, especially during turbulent markets.

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References

Aizenman, J., and Pasricha, G. K. Selective Swap Agreements and the Global Financial Crisis. NBER Working Paper No. 14821, 2009.

Alexander, C., and Kaeck, A. "Regime Dependent Determinants of Credit Default Swap Spreads." *Journal of Banking and Finance* 32 (No. 6 2008): 1008-21.

Blanco, R., Brennan, S., and Marsh, I. W. "An Empirical Analysis of the Dynamic Relation between Investment-Grade Bonds and Credit Default Swaps." *Journal of Finance* 60 (No. 5 2005): 2255-81.

Duffie, D. "Credit Swap Valuation." *Financial Analysts Journal* 55 (No. 1 1999): 73-87.

Eichengreen, B., and Mody, A. "What Explains Changing Spreads on Emerging Market Debt?" In Sebastian Edwards (ed.), *Capital Flows and the Emerging Economies: Theory, Evidence, and Controversies.* Chicago: The University of Chicago Press, pp. 107-36, 1998.

Grandes, Martin. Convergence and Divergence of Sovereign Bond Spreads: Lessons from Latin America. OECD Development Centre Working Paper No. 200, 2002.

Houweling, P., and Vorst, T. "Pricing Default Swaps: Empirical Evidence." *Journal of International Money and Finance* 24 (No. 8 2005): 1200-25.

Kamin, S. B., and von Kleist, K. The Evolution and Determinants of Emerging Market Credit Spreads in the 1990s. BIS Working Papers No. 68, May, 1999.

Merton, R. C. "On the Pricing of Corporate Debt: the Risk Structure of Interest Rates." *Journal of Finance* 29 (No. 2 1974): 449-70.

Park, C., and Seo, J. "Analysis of Determinants of External Debt." *International Finance Review.* The Bank of Korea, 2006 (in Korean).

Zhang, B. Y., Zhou, H., and Zhu, H. Explaining Credit Default Swap Spreads with Equity Volatility and Jump Risks of Individual Firms. BIS Working Papers No. 181, 2005.